I HEREBY CERTIFY THAT THIS CORRESPONDENCE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE AS FIRST CLASS MAIL IN AN ENVELOPE ADDRESSED TO: COMMISSIONER FOR PATENTS, P.O. BOX 1450, ALEXANDRIA, VA 22313-1450, ON THE DATE INDICATED BELOW.

BY: Diane Sutter Date: 9/29/03

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re:	Patent Application of Kevin Guangjun Cai, *et al.*	: Group Art Unit: 2831
Conf. No.:	2527	:
Appln. No.:	09/776,676	: Examiner: Chau N. Nguyen
Filed:	February 6, 2001	:
For:	KAOLIN ADDITIVE IN MINERAL INSULATED METAL SHEATHED CABLES	: Attorney Docket No. **600214-47US** **(32536)**

DECLARATION OF KEVIN GUANGJUN CAI, PH. D., UNDER 37 C.F.R. §1.132

I, Kevin Guangjun Cai, Ph.D., declare and state as follows:

1. I am an inventor of the invention in the above-identified patent application.

2. Since 1998, I have been employed as a Research & Development Engineer and Metallurgist at Tyco Thermal Controls (Pyrotenax) at 250 West, Trenton, Ontario. Prior to my employment with Tyco Thermal Controls, I was a Research Associate in the Department of Metallurgical and Material Engineering at Queens University (Canada) from 1997 to 1998. I was also an Associate Professor at Southwest Jiaotong University, Chengdu, China, from 1994 to 1996.

3. I have been involved with conducting research in the field of material science and engineering since about 1980. In 1980, I graduated from the Kunming University of Science and Technology, Kunming, China. In 1985, I received my Master's Degree in Material Science

from Southwest Jiaotong University, Chengdu, China. I also received both a Licentiate Degree in Material Science (1993) and my Doctorate Degree in Material Science and Applied Physics (1994) from Chalmers University of Technology, Gothenburg, Sweden.

4. Since about 1998, my research at Tyco Thermal Controls has been related to the development of cable and cable products. In particular, my research has been related to additives for improved properties of mineral-insulated (MI) cables used in the fields of electricity transportation, electric heat tracing and temperature measurement, for example.

5. I am familiar with the prosecution of this patent application and, in particular, the Office Action dated March 31, 2003 (Paper No. 18), including the rejection of claims 21-35 as being obvious over U.S. Patent No. 6,466,123 of Kuzuoka et al. in view of the *Condensed Chemical Dictionary*, 10th Ed., revised by Hawley.

6. As discussed in Applicants' application, metal sheathed MI cables, which contain a filler having a mineral insulation disposed between an outer sheath and a metallic conductor(s), are susceptible to absorption of water which can result in a decrease in the resistivity of the insulation and the conductor, as well as failure of the cable. Different methods and materials have been explored to reduce moisture infiltration to cables; however, no method or material is known to have the success of the present invention.

7. By the present invention, Applicants have discovered an improved: cable; method of manufacturing a metal sheathed MI cable; method of reducing moisture infiltration to a cable; and method of reducing a decrease in resistivity of a cable.

8. Various experiments and testing of cables were previously conducted by me or under my supervision, and I am submitting this Declaration to help the Examiner understand non-obviousness of the claimed invention and to demonstrate unexpected results. Generally, the

purpose of the experiments was, among other things, to determine the effect that a magnesium oxide (MgO) and kaolin powder mineral insulation filler has on a metal sheathed cable. The experiments are described below, and the test results are set forth in several figures attached hereto.

9. In the experiments, metal sheathed MI cables were formed by filling a metal sheath with a metallic conductor and a powdered mineral insulation filler such that the filler was between the outer sheath and the conductor, and drawing down the sheath. The cables were then tested by measuring several physical properties, including the insulation resistance (IR) of the cable.

Experiment 1

10. More specifically, in a first experiment, a metal sheathed cable, which contained a thermocouple (metallic conductor), was filled with magnesium oxide (MgO) filler and drawn down. In a separate part of the same experiment, a second cable was prepared in the same manner as the first cable except that about 15% by volume of kaolin was mixed with MgO filler prior to drawing down the cable.[1] During both parts of Experiment 1, the relative humidity was approximately 70%. The IR of both the MgO filled cable ("Standard powder") and the cable filled with MgO/kaolin mixture ("With kaolin") were determined over time, and the results of the IR measurements are shown in Figure 1.

11. The results of Experiment 1, as shown in Figure 1, demonstrate that a cable made by the method of manufacturing as claimed and having, in particular, a filler which is a mixture of MgO and about 15% by volume kaolin ("With kaolin"), has unexpectedly higher IR

[1] In Experiment 1, as well as the additional experiments described below, kaolin was added to MgO by volume percentage instead of by dry weight percentage. However, since the density of kaolin is 1.8-2.6 g/cm^3, the volume percentage and dry weight percentage of kaolin can be used approximately interchangeably. *See* www.jtbaker.com/msds/englishtml/K0870.htm.

over time in comparison to a cable made by the same method but having a MgO filler without the addition of kaolin ("Standard powder"). Thus, the cable with the higher IR over time experienced a reduced decrease in resistivity in comparison to the other cable. Also, since IR is inversely related to the penetration of water into a cable, inventive Experiment 1 also shows that a cable made by the method as claimed whereby the filler is a mineral insulation mixture of MgO and kaolin, as opposed to just MgO, results in reducing moisture infiltration to the cable.

Experiment 2

12. In a second experiment, a metal sheathed cable was again prepared as described in paragraph 9 where the insulation filler was MgO ("Without kaolin"). Similar to Experiment 1, in a separate part of Experiment 2, a second cable was prepared in the same manner as the first cable except that about 20% by volume of kaolin was mixed with MgO filler ("With kaolin") prior to drawing down the cable. Additionally, the cables in Experiment 2 were exposed to an environment having approximately 40% relative humidity to determine the cables' insulation resistance (IR) at various times. The results from this testing are shown in Figures 2 and 3.

13. Similar to the results of Experiment 1, the results of Experiment 2, as shown in Figures 2 and 3, demonstrate that a cable made by the method of manufacturing as claimed and having, in particular, a filler which is a mixture of MgO and about 20% by volume kaolin ("With kaolin"), has unexpectedly higher IR when exposed to about 40% relative humidity and, therefore, a reduced decrease in resistivity over time in comparison to a cable made by the same method but having a MgO filler without the addition of kaolin (Without kaolin"). Figures 2 and 3 differ in that the insulation resistance in Figure 3 was plotted on a log scale and over a longer period of time in comparison to Figure 2. Again, since IR is inversely related to the penetration

of water into a cable, inventive Experiment 2 also shows that a cable made by the method as claimed whereby the filler is a mineral insulation mixture of MgO and kaolin, as opposed to just MgO, results in reducing moisture infiltration to the cable.

Experiment 3

14. Similar to Experiment 2, in a third experiment, two metal sheathed cables were prepared as described in paragraph 9, wherein the first cable contained only a MgO insulation filler ("Without kaolin") and a second cable contained a filler of about 20% by volume of kaolin mixed with MgO ("With kaolin"). However, in Experiment 3, the cables were exposed to an environment having approximately 65% relative humidity to determine the cables' IR at various times. The results from this testing are shown in Figures 4 and 5.

15. The results of Experiment 3, as shown in Figures 4 and 5, further demonstrate that a cable made by the method of manufacturing as claimed and having, in particular, a filler which is a mixture of MgO and about 20% by volume kaolin ("With kaolin"), results in a reduced decrease in resistivity (higher IR) over time of the cable and, thus, the reduction of moisture infiltration to the cable. It is pointed out that, like Figures 2 and 3, Figures 4 and 5 differ in that the insulation resistance in Figure 5 was plotted on a log scale and over a longer period of time in comparison to Figure 4. By doing so, it is more clearly shown that, even at a relative humidity of about 65%, a reduction in the decrease in resistivity of a cable is realized where the cable contains a filler which has a mixture of MgO and kaolin.

Experiment 4

16. In a fourth experiment, four metal sheathed cables were prepared as described in paragraph 9 at approximately 30% relative humidity. In a first part of Experiment 4, two cables were prepared using only MgO as the insulation filler ("Std. MgO-1" and "Std. MgO-2").

In a separate part of the same experiment, two additional cables were prepared in the same manner as the first two cable in Experiment 4 except that about 3% by volume of kaolin was mixed with MgO ("Kaolin-1" and "Kaolin-2") to form a filler prior to filling and drawing down the cables. The IRs of all four cables were determined over time, the results of which are shown in Figure 6.

17. The results of Experiment 4, as shown in Figure 6, demonstrate that cables made by the method of manufacturing as claimed and having, in particular, fillers which are a mixture of MgO and about 3% by volume kaolin ("Kaolin-1" and "Kaolin-2"), has unexpectedly higher IR and, therefore, a reduced decrease in resistivity over time in comparison to a cable made by the same method but having a MgO filler without the addition of kaolin ("Std. MgO-1" and "Std. MgO-2").

<u>Summary</u>

18. The results from the testing conducted on the various cables described above demonstrate that cables filled with a powdered mineral insulation filler comprising MgO and about 3% to about 20% kaolin result in a higher IR than cables which only contain a MgO filler.

19. It therefore follows that the results of Experiments 1-4 confirm that Applicants have discovered an improved cable as well as improved and unexpected methods of reducing moisture infiltration to a cable and for reducing a decrease in resistivity of a cable.

20. Based on the forgoing results, I believe that the cable and methods of the claimed invention are different from and not obvious over or in view of the cables and methods recited in the prior art of record, and achieve unexpected results with respect to reducing moisture infiltration to a cable and reducing a decrease in resistivity of a cable.

I hereby declare that all statements made herein of my own knowledge are true and that any statement made on information or belief are believed true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of United States Code and that such willful false statements may jeopardize the validity of the application and any patent issuing thereon.

Sept. 26/03
Dated

Kevin Cai
Kevin Guangjun Cai

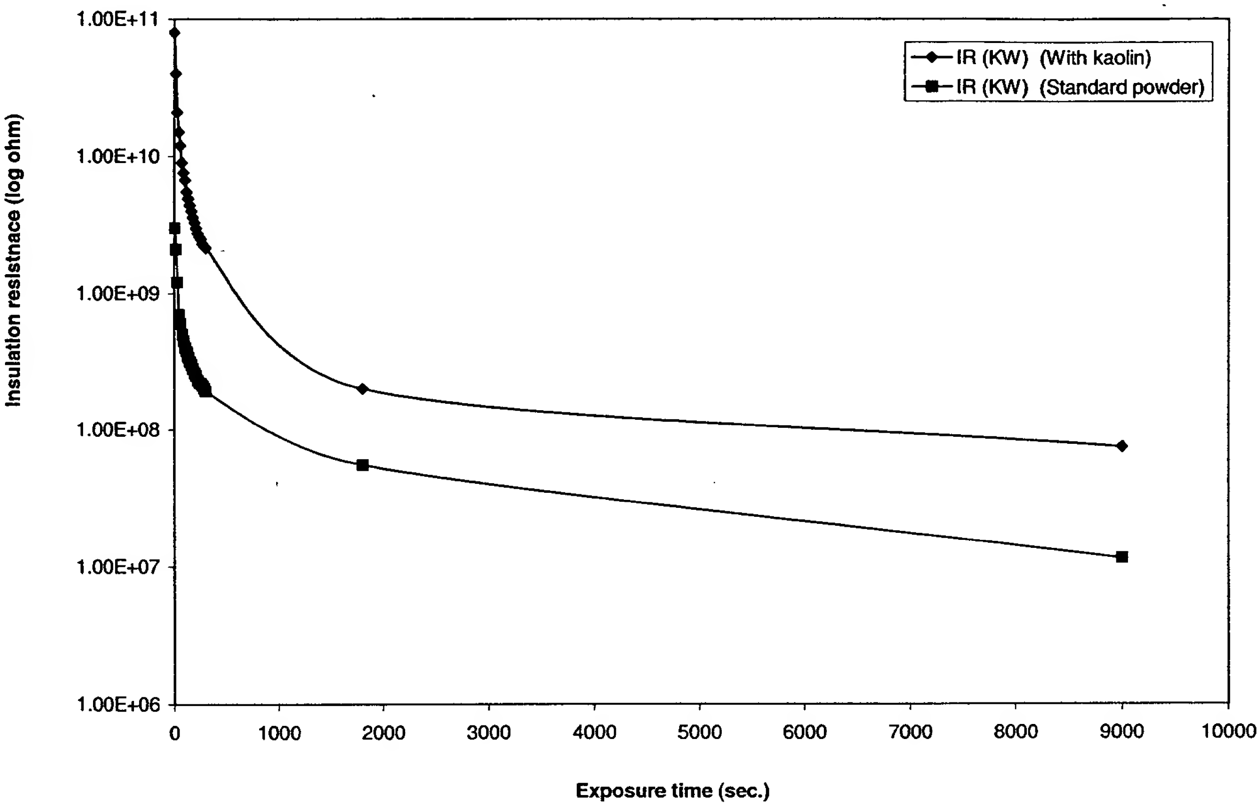

FIGURE 1. Insulation Resistance (log scale) vs. Exposure Time: Cable with MgO Filler Comparison to Cable with MgO and about 15% Kaolin Filler at ~70% Relative Humidity

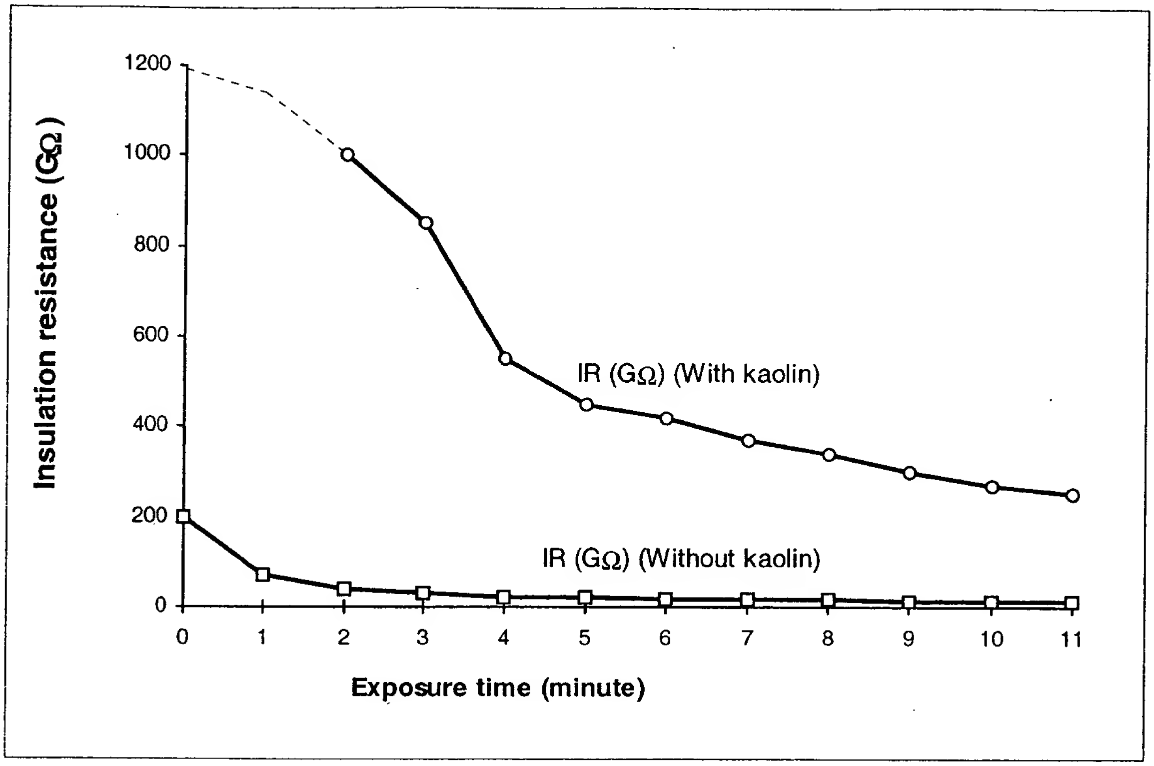

FIGURE 2. Insulation Resistance vs. Exposure Time: Cable with MgO Filler Comparison to Cable with MgO and about 20% Kaolin Filler at ~40% Relative Humidity

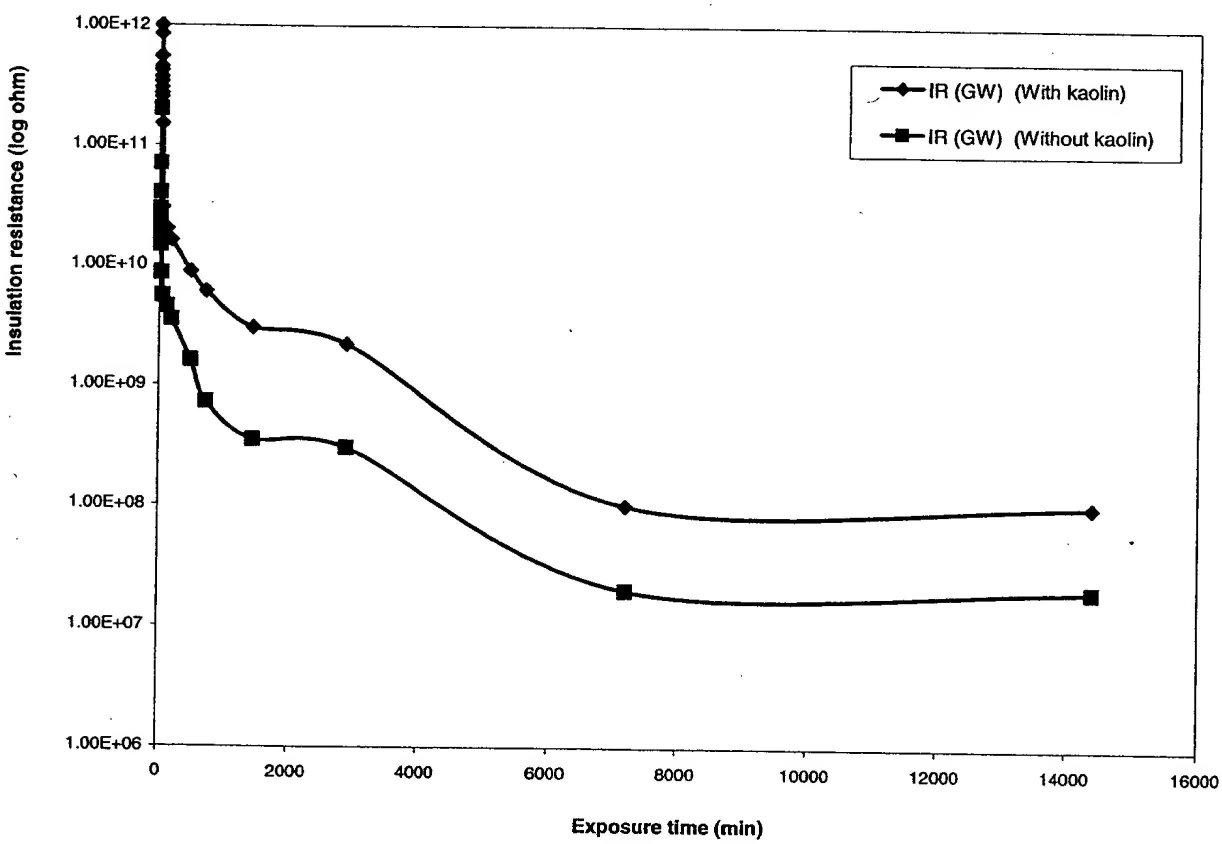

FIGURE 3. Insulation Resistance (log scale) vs. Exposure Time: Cable with MgO Filler Comparison to Cable with MgO and about 20% Kaolin Filler at ~40% Relative Humidity

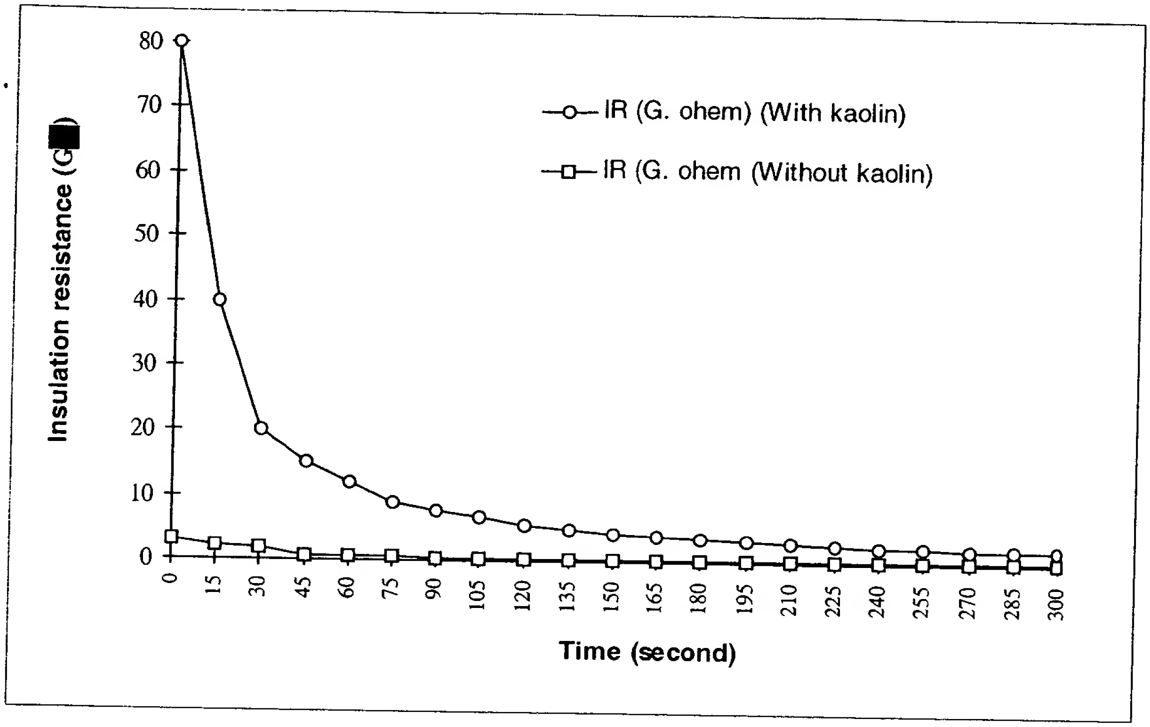

FIGURE 4. Insulation Resistance vs. Exposure Time: Cable with MgO Filler Comparison to Cable with MgO and about 20% Kaolin Filler at ~65% Relative Humidity

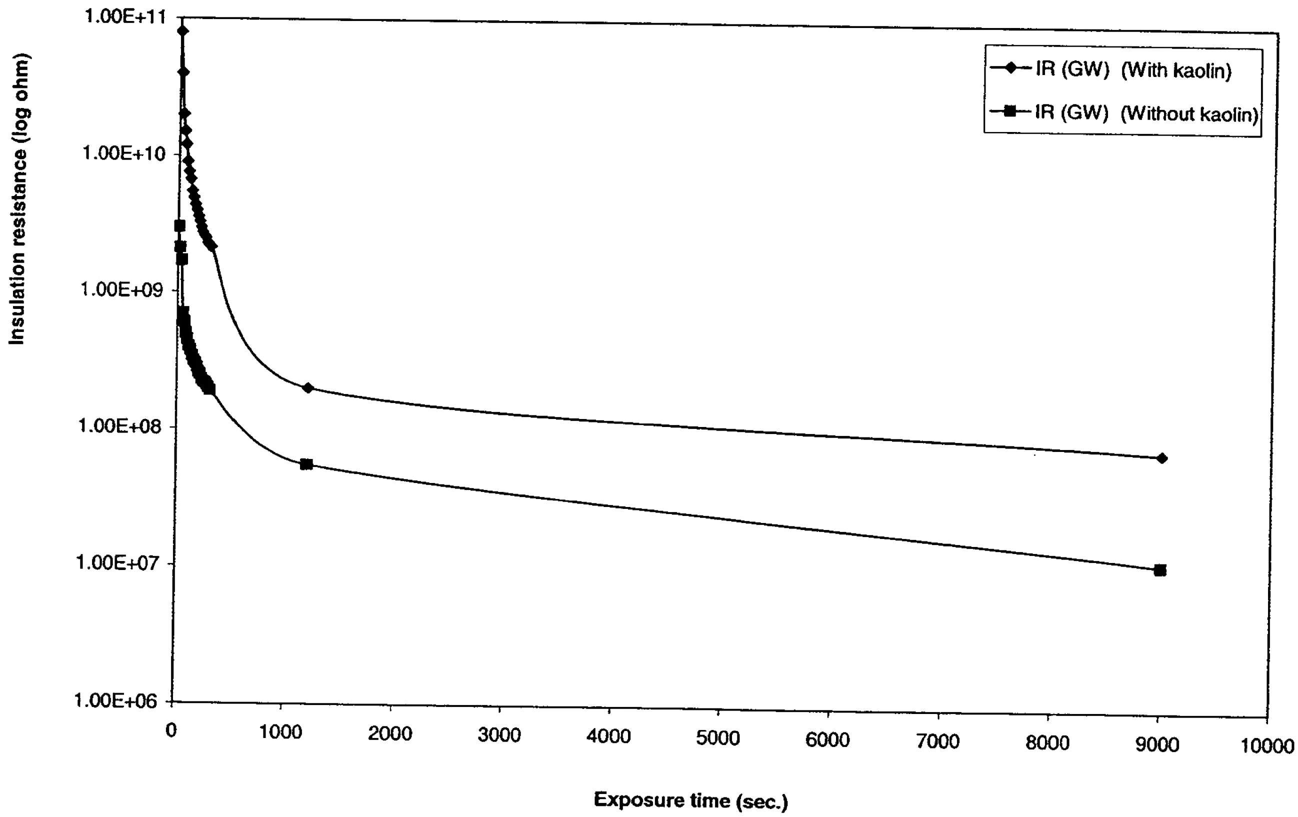

FIGURE 5. Insulation Resistance (log scale) vs. Exposure Time: Cable with MgO Filler Comparison to Cable with MgO and about 20% Kaolin Filler at ~65% Relative Humidity

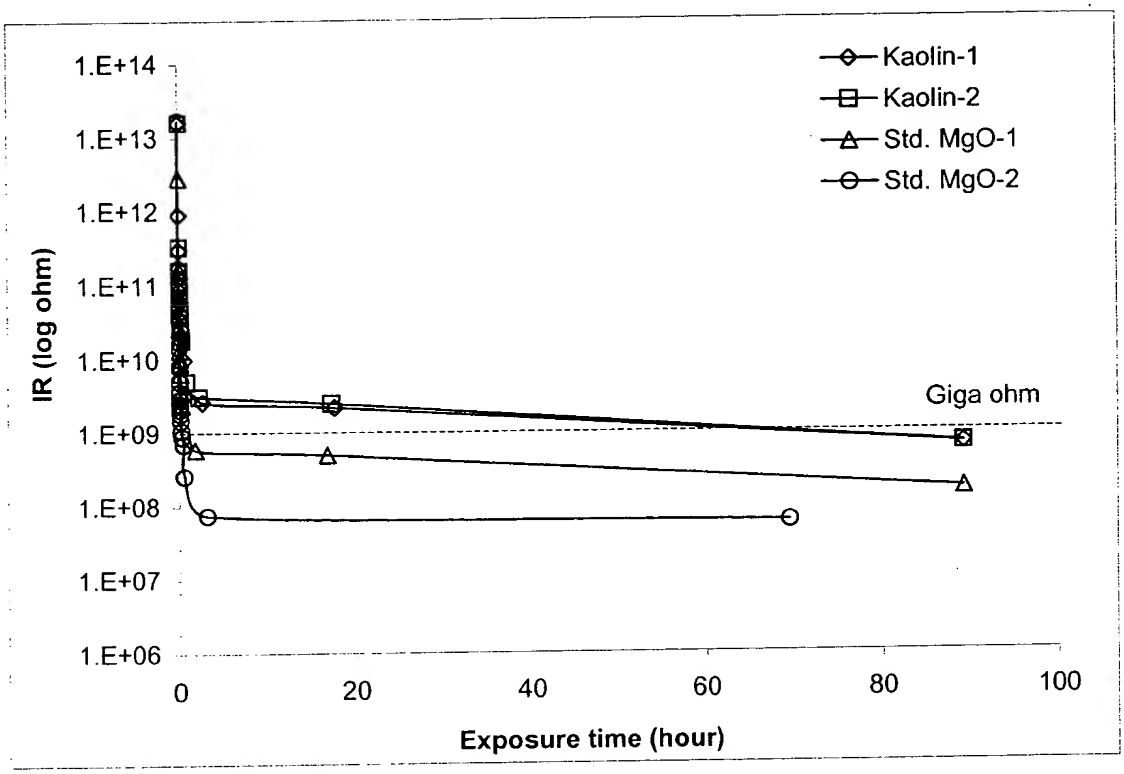

FIGURE 6. Insulation Resistance (log scale) vs. Exposure Time: Cable with MgO Filler Comparison to Cable with MgO and about 3% Kaolin Filler at ~30% Relative Humidity